OF ABUTMENTS.

Much of the failure in modern edifices results from the defective nature of their abutments.

The abutment must always be sufficient to sustain the weight, thrust, or moving power, which it has to resist; and it should be more than sufficient; otherwise the slightest accident, as additional weight irregularly disposed, yielding of foundation, sudden emergency or shock, will render it insufficient. Thus the limbs of two similar arches, meeting upon one pier, afford an abutment to each other, of the most perfect kind: but if one of the abutments supporting the other limb of one of the arches, be so weak as to cause one of the arches to give way, the other arch may also lose its exact equilibrium. Again, if one of the arches have upon its crown more weight than the other, the other arch also may be made to settle irregularly; hence it becomes necessary, that besides unflinchingness of foundation, there must be abutment sufficient to resist all accident.

The most perfect system of abutment is that which is in all respects equal: thus, for instance, the inclined sides of a hollow conical

or pyramidal steeple afford abutment of bulk, inclination, certainty of material, and weight, equal to those of each opposite side; and the entire circuit of abutments gives to the whole perfect equilibrium, which nothing but violent accident, or undue settlement at the foundation, can in the slightest degree derange; and even after such settlement has taken place, frequently no fracture is observable: hence a steeple, consisting of four or more open buttresses, at which the moderns shake their heads in fear and trembling, is a more safe and certain mode of construction than modern square towers, which, by the slightest settlement, have a tendency to fall apart, and overhang, and after that to fall to premature decay, merely by the weight of their materials.

Thus the circular drum beneath the dome of Saint Paul's is conical, settlement tending to consolidate its whole circuit of counter-abutments, and its form adding great charm to the internal perspective of the building,—while the perpendicular drum under the cupola of the boasted Basilica of Saint Peter, at Rome, is split in many places down to its very base, by the gravity and outward thrust of the cupola above it.

Perhaps there can hardly be found in the world a specimen of exact counter-abutment more beautiful than the twelve stone curved ribs (forming a skeleton dome), which rise in a circle from the columns to the upper work of Bow-steeple, Cheapside. They may indeed afford a lesson in the art of constructing real domes, for they shew with what safety ribs may be raised from piers, which may support a roof of slabs of stone, which may be lapped over each other so as to prevent the penetration of rain, which will ruin any ordinary dome, the joints of which radiate to the centre of the curvature; and while the masonic stone work of such a skeleton dome might settle considerably in each distinct rib without shewing any flaws like those in the dome of the Vatican, even the weight of the stone covering slabs may be made to act in some sort as a counter abutment to each rib.

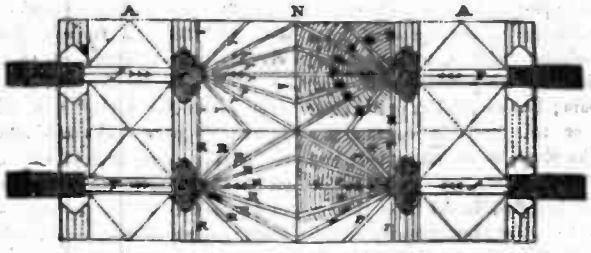
Dr. Hutton, in his History of Iron Bridges, gives the following curious account of the failure of the iron bridge at Staines, which appears to have been almost exactly poised upon its abutments, and to have failed, either because there was no excess of gravity in the abutments, or because their gravity was not made to operate directly against the active force of the arch.

"From the completion of the above bridge" (viz. the iron bridge over the River Parret, at Bridgewater) "few of any note were executed in this country, till about the year 1800, when the stone bridge erected over the Thames at Staines gave way. On this occasion the magistrates of the counties of Middlesex and Surrey came to a resolution to erect an iron bridge there, on the abutments of the stone bridge, the piers of which had failed; and Mr. Wilson, the agent of Mr. Burdon, was employed for this purpose. He accordingly undertook the construction of an iron arch of 181 feet span, with 16½ feet rise or versed sine, the arch being a segment of a circle. In this bridge the ribs were similar to those of Wearmouth; but instead of having the blocks, of which the ribs are composed, kept together by worked iron bars, let into grooves in their sides, the rings of the ribs were cast hollow, and a dowel was let into the hollow ring at each joint, so that the two adjacent blocks were fixed together by this dowel, and by keys passing through the rings. The ribs were also connected transversely by frames, instead of pipes, as in the Sunderland bridge. The haunches were filled with iron rings, and the whole was covered with iron plates.

"It is to be noted, that an iron arch, in small blocks, is not set up after the manner of a stone one, by beginning at the abutments, and building upwards; but is begun at the top, and continued downwards; it being easier to join the stone to the iron, than to cut the iron at the top, if it should not fit. It is somewhat remarkable, therefore, that when these ribs were put together, and before they joined the masonry, it was so nicely balanced, and its parts were so firmly locked together, that after all the supports were taken out, except those next the abutment, the whole was moved by a man, with a crowbar under the top, and it seemed to have little tendency to push the abutments asunder. This, however, turned out unfortunately not to be the case. The centering was taken away, and the bridge was opened for the use of the public, about the end of the year 1801, or beginning of 1802. At first it seemed to stand firm, and the public were much pleased with its light and elegant appearance. But in a short time it was found that the arch was sinking; and soon after it had gone so much, that it was obliged to be shut up, and the old bridge opened again. The sinking of the arch broke several of the transverse frames, and many of the radii at the haunches; which left no doubt that the abutments had given way. But on examination there appeared no visible sign of such failure: there was not a crack in the masonry, nor had they gone out of the upright. After much investigation, however, it appeared that the whole masonry of the abutments, to the very foundation, had slidden horizontally backwards, still preserving the perpendicular, or upright position. The failure took place in the south abutment, which was supposed to be owing to a cellar, that had been made in it. The inhabitants of Staines, therefore, by the advice of an engineer whom they had consulted, had this abutment strengthened: but no sooner was this done, than the north one failed: and they had intended to strengthen this also; but their funds being nearly exhausted, they came to the resolution to take the whole down, and erect a wooden bridge in its stead."—*London Edition*, A.D. 1812, p. 149.

Were it the author's wish to prove, by one example more striking than any other, the falling off of science in the absolute practice of architecture, in these times of pretended superiority, in which the ill-taught practitioner who wishes to pursue the integrity of his art, is obliged, after he is turned adrift by his master, to re-educate himself as far as he is able, by picking up whatever scraps of scientific information may fall in his way, instead of receiving from his master at once the full depth of skill which the freemasons for centuries handed down from father to son, from master to pupil, without diminution and without reserve,—he would fearlessly instance the most singular advancement which the mid-eval architects seem, by nothing short of inspiration, to have made in the most delicate acquaintance with architectural dynamics; a knowledge which taught them at once to unite in their abutments, strength with economy, use with beauty: while in our ignorance we fancy that strength and economy are enemies of each other, and that use and beauty are of necessity opposite qualities. This refined intelligence taught them to render every necessary part of their constructions such exquisite ornaments, that the ignorant modern looking at them, without knowing their use, fancies them to be merely ornamental.

They first began in their vaultings with reducing the lateral thrust of the work to the smallest limits, by cutting out all the otherwise more level and hazardous parts of the vaulting, so that what remained scarcely left its perpendicular bearing upon the walls: they next greatly reduced further the weight of the vaulting, by forming it of small stone ribs, with a mere thin cuticle of lighter materials in short and narrow panels between the ribs; and whereas in our modern brick vaultings, the groin-points are weak by their bond, and are still weaker from the soft and inferior nature of the bricks of which they are composed (vulgarly termed "cutters," and wholly unfit for the purposes of any good work), and we know scarcely any thing of the dynamics of such a vault,—the mid-eval builder put all the strength in the ribs, strutted his ribs across as he deemed necessary, and made every strut a beauty, conducted the active force down those ribs as easily as water is conducted down a pipe, and then instead of leaving the active force within each rib to expend itself in committing unknown and unrestrained damage to the walls of the fabric, he united their force in one point so that he could deal with it as an active power well ascertained; then knowing by the laws of the resolution of forces the way in which the united thrust of the ribs would move, he counteracted by the smallest possible quantity of materials set in the form of flying buttresses, pinnacles, and wall-buttresses, that force which unrestrained might have endangered the walls. Thus by making use of only a small quantity of materials every particle of which was brought into active service, he was enabled to carve, ornament, and enrich every part of his fabric out of those funds which we ignorant moderns expend in raising coarse masses which perform no duty, or ill-directed, either waste much of their weight and strength, or else employ it in rending and dilapidating the fabric.



N. Nave.
A. A. Aisles.
R. R. &c. Ribs of the vaulting, the several thrusts of which all uniting at the centre C. the dynamic action is confined to one point tending to move from C to F.
F. Flying-buttress, falling against the point C in the direction exactly suited for opposing the united thrust of the vaulting-ribs.
B. Wall-buttress from which the flying-buttress springs.
P. Pinnacle.
The small letters indicate the repetition of sets of the same parts belonging to other divisions of the vaulting.

The author comes now to a department of the Dynamic Knowledge of the Gothic Archi-

To learn about PDF Compression and OCR visit our website